Floral diversity of the peat swamp forests of Sarawak

C.S. Tawan, I.B. Ipor and W.H. Wan Sulaiman

Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia
Phone: +60 82 583186, Fax: +60 82 583160, e-mail: cheksum@frst.unimas.my

Summary

The total peatland area of Sarawak is estimated to be about 1,657,600 hectares, representing 13% of the whole land area. Many of the peat swamp forests (PSF) have been harvested or transformed into agricultural lands and settlements along the coastal areas of Sarawak's lowland plains. Owing to the rapid transformation of the PSF, there has been increased attention on conserving some of what is left for biodiversity, water resources, recreation, ecotourism and other purposes, including that of being a carbon sink. The existing protected peat swamp areas are Loagan Bunut National Park, which encompasses 10,736 ha, Maludam National Park of 43,147 ha, Pulau Bruit Wildlife Sanctuary (1,776 ha) and several isolated islands of PSF located in Bako National Park, Samunsam Wildlife Sanctuary, and Mulu National Park. This paper presents a review of a study of the flora of the PSF in the Loagan Bunut National Park and the disturbed PSF of Kota Samarahan and Sedilo. In our inventory studies, the traditionally important trees of the peat swamp were also identified, namely *Gonystylus bancanus* Miq. Kurz. (Ramin), *Shorea albida* Sym. (Alan bunga), *Dactylocladus stenostachys* Oliv. (Jongkong), *Shorea inequilateralis* Sym. (Semayur), *Platea excelsa* Bl. (Jejangkong), *Dyera polyphylla* (Miq.) Steenis (Jelutong), *Dryobalanops rappa* Becc. (Kapur paya), *Cratoxylum glaucum* Korth. (Geronggang padang) and *Combretocarpus rotundatus* (Miq.) Dans. (Keruntum). Nevertheless, these species were no longer dominant in the disturbed habitat. This paper also discusses the importance of flora in the PSF ecosystem that plays an important role in enhancing the carbon sink and storage.

Key index words: peat swamp forest, floral diversity, Sarawak

Introduction

The land area of Sarawak is covered by diverse forest types ranging from mixed dipterocarp forest (57%), peat swamp forest (12%), kerangas or tropical heath forest (3%), mangrove forest (1%), beach or littoral forest (less than 1%), riverine or alluvial forest (less than 1 %), montane forest (less than 1%), limestone forest (less than 1 %), and secondary forest of various succession periods. The distributions of the forest types are influenced by several factors including soil type, altitude, topography, climate and geology. The current estimate of the vascular plants species in Sarawak is about 10,000-12,000 species.

The pristine peat swamp forest of Sarawak was considered unique when Anderson in 1963 and 1964 classified six distinct types of vegetation communities. The first community on shallow peat is known as mixed peat swamp forest. This type of forest is comparatively rich in species composition compared to the other five communities. The associated species present in this community are *Shorea albida - Dactylocladus* and *Neoscortechinia*. The second community is characterized by the presence of huge individuals of *Shorea albida* associated with *Gonystylus* and *Stenonurus spp*. The third community is also dominated by *Shorea albida*. The fourth community is known as padang alan and is dominated by *Shorea albida* with two other genera, *Litsea* and *Parastemon*. The fifth community that occurs near to the centre of the dome is referred to as padang paya with *Tristinia – Palaquium – Parastemon* as the common associated species. The central community is known as padang keruntum and is dominated by *Combretocarpus rotundatus* together with *Dactylocladus*. This is comprised of small and stunted trees resembling the features of woodland.

It has been reported that PSF plays an important role in global carbon balance. Its large biomass contributes to carbon sequestration and storage. Consequently, it is timely that intensive study on this fragile ecosystem should be given priority by the Government and stakeholders. Hence, the objective of this paper is to highlight the floral diversity of totally protected PSF compared to logged over PSF and to give better understanding of the ecosystem and the flora diversity of the remaining and existing PSF in Sarawak, for the purpose of biodiversity and ecosystem conservation.

Materials and methods

The data incorporated in this paper were derived from the brief floral inventory carried out in the following selected PSFs. The site at Universiti Malaysia Sarawak at the East Campus is located at 1° 27 N, 110°27 E in Kota Samarahan Division. It is considered as a re-established mixed peat swamp forest after being logged in 1957. This area is conserved for educational purposes. The survey was

conducted on a one ha plot comprising of 25 subplots of 20 x 20 m. The area at Sedilo is logged over mixed peat swamp forest located at 1° 26'N, 110° 48'E in Kota Samarahan Division. The samplings were only done using 3 plots of 20 x 20 m selected within the sites. The Loagan Bunut National Park is located at 3° 48'N, 114° 13'E. It was the first peat swamp to be gazetted as a National Park of Sarawak (in 1991) and encompasses an area of 10,736 of peat swamp while the huge lake within the park occupies 650 ha. Loagan Bunut National Park is one of the fascinating forests featured by its huge natural lake located in the upper reaches of Sungai Bunut, Miri. The floral survey was only done through samples collected from various locations in the Loagan Bunut National Park.

All tree species of ≥5 cm of diameter breast height (DBH) from the three sites were measured. Specimens were collected, oven dried and preserved accordingly for identification. Identifications were made at the Sarawak Herbarium (SAR). The heights of trees were measured using a Haga meter. The estimated above-ground biomass at the Universiti Malaysia Sarawak East Campus PSF and Sedilo PSF were determined by the methods of Yamakura *et al.,* 1986.

Results

Floral diversity and total above-ground biomass

The results of the study are as follows.

Universiti Malaysia Sarawak, East Campus PSF

In the one hectare plot a total of 1600 individual trees of DBH ≥ 5.0 cm from 167 species in 37 families were enumerated. The top ten families which showed a high number of species recorded were Lauraceae (19 species), Myrtaceae (14 species), Annonaceae (10 species) Euphorbiaceae (10 species) Fabaceae (9 species), Burseraceae (8 species), Anacardiaceae (7 species), Myrtaceae (7 species), Sapotaceae (7 species) and Clusiaceae (6 species). Other families identified were Dipterocarpaceae, Ebenaceae, Eleocarpaceae, Sapindaceae, Apocynaceae, Rosaceae, Aquifoliaceae, Bombacaceae, Celasteraceae, Meliaceae, Fagaceae, Icacinaceae, Melastomaceae, Moraceae, Oleaceae, Oxalidaceae, Polygalaceae, Rhizophoraceae, Rutaceae, Alangiaceae, Magnoliaceae, Myrsinaceae, Simaroubaceae, Sterculiaceae, Tetrameristaceae, Thymelaeaceae, Tiliaceae, Based on the DBH classification, the percentage of 1600 individuals trees enumerated were as follows:- 905 (56.6%) individuals with DBH ranging from 5-10.0 cm, 481(30.1%) individual trees with 10.1-20.0 cm DBH, 123 (7.7%) individual trees with 20.1-30 cm DBH, 34 (2.12%) individual trees with 30.1-40.0% and only 5 (0.3%) individual trees with 40.1-50 cm while only individual with 50.1 - 60 cm DBH and only 1 (0.06%) individual with 60.1-70 cm DBH (Ipor, *et al.*, 2006).

The ten families which contributed to the most TAGB were Sapotaceae (69,482.56 kg/ha), followed by Euphorbiaceae (38,360.47 kg/ha), Sapindaceae (23,722.15 kg/ha), Lauraceae (17,155.28 kg/ha), Bombacaceae (14,432.08 kg/ha), Anacardiaceae (13,123.66 kg/ha), Annonaceae (9,896.46 kg/ha), Myrtaceae (8,446.65 kg/ha), Fabaceae (7,561.64 kg/ha) and Apocynaceae (7,004.24 kg/ha) (Ipor *et al.*, 2006)

Sedilo PSF

From the three plots surveyed, a total of 218 trees with a DBH of ≥5 cm from 22 families comprising 47 species were recorded. The top ten families which showed a high number of species recorded were Dipterocarpaceae (37 species), Sapotaceae (25 species), Myrtaceae (24 species), Polygalaceae (20 species), Lauraceae (14 species), Annonaceae (13 species), Myristicaceae (11 species), Euphorbiaceae (10 species), Fagaceae (10 species) and Dilleniaceae (9 species). The other families recorded were Ebenaceae, Aquifoliaceae, Rubiaceae, Anarcardiaceae, Linaceae, Burseraceae, Fabaceae, Thymelaeaceae, Sapindaceae, Apocynaceae, Icacinaceae and Oleaceae. Of the 218 individuals trees enumerated, 131 (60.1%) individuals with DBH ranging from 5-10.0 cm, 50 (22.9%) individual trees with 10.1-20.0 cm DBH, 20 (9.2%) individual trees with 20.1-30 cm DBH, 9 (4.1%) individual trees with 30.1- 40.0% and only 8 (3.7%) individual trees with 40.1-50 cm.

The ten families which contributed most to the TAGB were Dipterocarpaceae (8,617.69 kg/ha), Thymelaeaceae (6,119.42 kg/ha), Sapotaceae (4,001.48 kg/ha), Lauraceae (3,346.18 kg/ha), Euphorbiaceae (3,118.57 kg/ha), Annonaceae (3,078.83 kg/ha), Fagaceae (2,615.69 kg/ha), Myrtaceae (1,666.96 kg/ha), Polygalaceae (1,589.55 kg/ha) and Myristicaceae (942.01 kg/ha)

Loagan Bunut National Park PSF

From the survey conducted from the four sites of the peat swamp forest viz: Teluk Udang, Teluk Bedil, Sungai Babi, Teluk Lepa and along Sungai Bunut in the Loagan Bunut National Park a total of 97 species from 42 families have so far been identified. Among these species several were important commercial peat swamp species. These species were *Gonystylus bancanus (Miq.) Kurz., (Ramin) Shorea albida (Alan bunga), Dactylocladus stenostachys (Jongkong), Shorea inequilateralis (Semayur), Platea, Dyera polyphylla (Jelutong), Dryobalanops rappa (Kapur paya), Cratoxylum glaucum (Geronggang padang), Combretocarpus rotundatus (Keruntum)* and *Tristianiopsis beccariana (Selunsor merah).*

Several ferns were identified namely *Asplenium nidus* (Paku bajang), *Atrophyum callifolium* (Paku pakis), *Dynaria quercifolia* (Paku pakis), *Huperzia phlegmaria* (Ekor tupai), *Lindasaya scandens* (Paku pakis), *Selaginella willdenowii, Stenochlaena palustris* (Midin), *Syngramma cartilagidens* (Paku pakis), *Platycerium ridleyi* (Tanduk rusa), *Platycerium coronarium* (Tanduk rusa). Four species of nepenthes are commonly found growing as climbers or scramblers on the wet forest floor and surrounding shrub and trees. The species identified were *Nepenthes ampularia*, *N. bicalcarata, N. gracilis* and *N. rafflesiana.* Several orchid species had been identified namely *Agrostophyllum bicuspidatum*, *Bulbophyllum beccarii* (Orkid telinga gajah), *Cymbidium finlaysonia*, *Dendrobium onosmum, Grammatophyllum speciosum. Bulbophyllum beccarii* is endemic to Borneo occurring in Brunei, Kalimantan, Sabah and Sarawak (Wood, 1997). On the forest flower some aroid herbs were found. Among the species identified are *Alocasia longiloba*, and *Aglaonema simplex* and *Labisia pumila.* The larger trees are normally habitats for numerous epiphytic species such as *Aeschynanthus, Asplenium nidus, Dynaria quecitifolia*, *Dendrobium amonum*, *Hoya* and *Urceola.*

Discussion

Based on the previous study by Anderson (1963, 1964), the pristine natural PSF of Sarawak was rich in plant diversity with several endemic species from six distinct communities. He enumerated a total of 1528 dicotyledons, 106 monocotyledons, 6 gymnosperms and 66 species of pteridophytes inhabiting this PSF. The forest has been well known as an important habitat for several endemic plants of Borneo such *Coipfera palustris*, *Dactylocladus stenostachys*, *Dryobalanops rappa*, *Shorea albida*, *Shorea inaequilateris* and *Shorea uliginosa* (Tawan, 2006). These are large timber trees and contribute large biomass to the PSF. *Gonystylus bancanus* is one of the most popular tropical timbers and is specifically confined in this type of forest. Its population was once dominant in the natural habitat but is now greatly depleted. It has also been reported that this species showed poor regeneration (Tawan, 2007). This species is now listed under Appendix 11 of the CITES (Convention of International Trade of Endangered Species).

The six types of community mentioned by Anderson (1963) still exist in Loagan Bunut National Park, although in some areas its ecosystem had been disturbed due to logging activities. It was noted that the peat swamp forest of Loagan Bunut is still rich in its flora composition. Several species that were found in Loagan Bunut National Park are protected under the Wild Life Ordinance of Sarawak, 1998. Examples of the species are *Nepenthes* spp., *Huperzia phlegmaria*, *Aeschynanthus* sp. The species composition in the other two study sites, Universiti Malaysia Sarawak East Campus and Sedilo, are basically altered. This is evidence that there are different top ten families recorded in both sites. Both sites recorded very few trees with the DBH greater than 30 cm that indicated larger trees have been extracted in the past. However, no attempt was made to compare the two sites in their species diversity and TABG as the number of plots taken from Sedilo was far fewer than at Universiti Malaysia East Campus. It is suggested that permanent research plots of at least one ha in selected PSF should be made for comparative study in the future.

Peat swamp in Sarawak is considered a very important natural resource and has been providing economic benefits use for the forest industry, agricultural development, water source, ecotourism, minor forest products, sources for food and medicine to the local community. In actual fact, the logging activity was first introduced in 1950s by the British Colonial Government concentrated in the coastal area of PSF. This timber industry contributed much to the state revenue. The timber extraction from the PSF was carried out until in the1970s when the logging activities intensified in the hill forests (Sawal, 2003). Realising the importance of the PSF, the State government gazetted two major areas as totally protected area (TPA), the Loagan Bunut National Park and Maludam National Park. However, in some repeated logged PSFs areas, the forest condition was very much degraded and contributed negative impacts to ecosystems and environment. These degraded areas obviously require a long term rehabilitation programme. The environmental significance and function of PSF is due to its unique hydrology system. The organic plant materials remain undecomposed in the peat soil due to waterlogged condition and through the natural processes of the peat swamp is capable to act as a carbon sink rather than as a carbon source (Sawal, 2003). The existence of PSF vegetation with high total of above-ground biomass would lead to a more efficient role to maintain the carbon balance in the environment. Large timber species such as *Shorea albida, Gonystylus bancanus, Dryobalanops rappa*, *Dactylocladus stenostachys Shorea inequilateralis, Platea excelsa, Dyera polyphylla, Cratoxylum glaucum, Combretocarpus rotundatus,* which produce high amount of above-ground biomass should be selected for enrichment planting to rehabilitate degraded PSF.

The preservation of PSF is also important for the ecotourism industry. Foreign and local nature lovers are normally attracted to experience and observe the great diversity of species and the spectacular view of the truly tropical forest environment. As discussed by Lim *et al.* (2005), activities in ecotourism which involves jungle trekking, farm tours, cultural shows and home stay programmes are beneficial to increase the socio-economy of the local people. Thus, it is important to conserve our PSF not only as a national heritage but serves as a reservoir for carbon storage.

Acknowledgements

We wish to express our special thanks to the Sarawak Forestry Department, Sarawak Forestry Corporation for their invaluable cooperation during the survey conducted in the various areas. We would like also to thank the Ministry of Science and Technology and Environment and Universiti Malaysia Sarawak for the research funding and to all the supporting staff of the Plant Science and Environmental Ecology for their assistance through out the projects.

References

Anderson, J.A.R. (1963). The flora structure of the peat swamp forest of Sarawak and Brunei. *Gardens Bulletin Singapore* **20**,131-228.

Anderson, J.A.R. (1964). The structure and development of the peat swamp forest of Sarawak and Brunei. *Journal Tropical Geography* **18**.

Ipor, I.B., Tawan, C.S. and Mustafa, H.S. (2006). Floristic Structure and Tree Species Composition. In F. Abang, and I. Das, (eds.), *The Biodiversity of a Peat Swamp Forest in Sarawak,* 61-86. Universiti Malaysia Sarawak Publication.

Lim, H.F., Woon, W.C. and Mohd. Farid, M. (2005). Improving the socio-economic livelihood of indigenous communities via eco-tourism development in Malaysia. In W. Nyoman, R.A. Lingam, S. Chubo. J.K. James, G. Zamri, Bokhari, S. (eds.). *Proceeding International Forestry Seminar: Synergistic Approach to Appropriate Forest Technology for Sustaining Rainforest Ecosystem.* UPM Publication. pp. 137-146.

Tawan, C.S. and Ipor, I.B. (2007). *Gonystylus bancanus* (Miq.) Kurz. (Ramin): A potential species for rehabilitation of the peat swamp forest in Sarawak. In I.B Ipor, C.S. Tawan, P. Bulan, I. Jusoh, B.A. Fasihuddin and K. Meekiong (eds.), *Proceedings of Conference on Natural Resource in the Tropics: Development and Commercialization of the Tropical Natural Resources,* 391-394. Lee Ming Press, Sdn. Bhd. Kuching, Sarawak, Malaysia.

Tawan, C.S. (2006). Plant Diversity and commercial timbers. In F. Abang, and I. Das, (eds.), *The Biodiversity of a Peat Swamp Forest in Sarawak*, 29 - 60. Universiti Malaysia Sarawak Publication.

Sawal, P. (2003). *Threats to Peat Swamp Forests (PSF) of Sarawak Final Report*. The Netherlands-Malaysia Project on the sustainable management of peat swamp forests of Sarawak with Special Reference to Ramin (*Gonystylus bancanus*). Sarawak Forestry Department, 42pp.

Wood, J.J. (1997). *Orchids of Borneo, Vol. 3. Dendrobium, Dendrochilum and others.* The Sabah Society, Kota Kinabalu and Royal Botanic Gardens Kew, 299pp.

Yamakura T, Hagihara, A., Sukargjo, S. and Ogawa, H. (1986). Above ground biomass of tropical rainforest stands Indonesia, Borneo. *Vegetatio* **68**, 72-82.